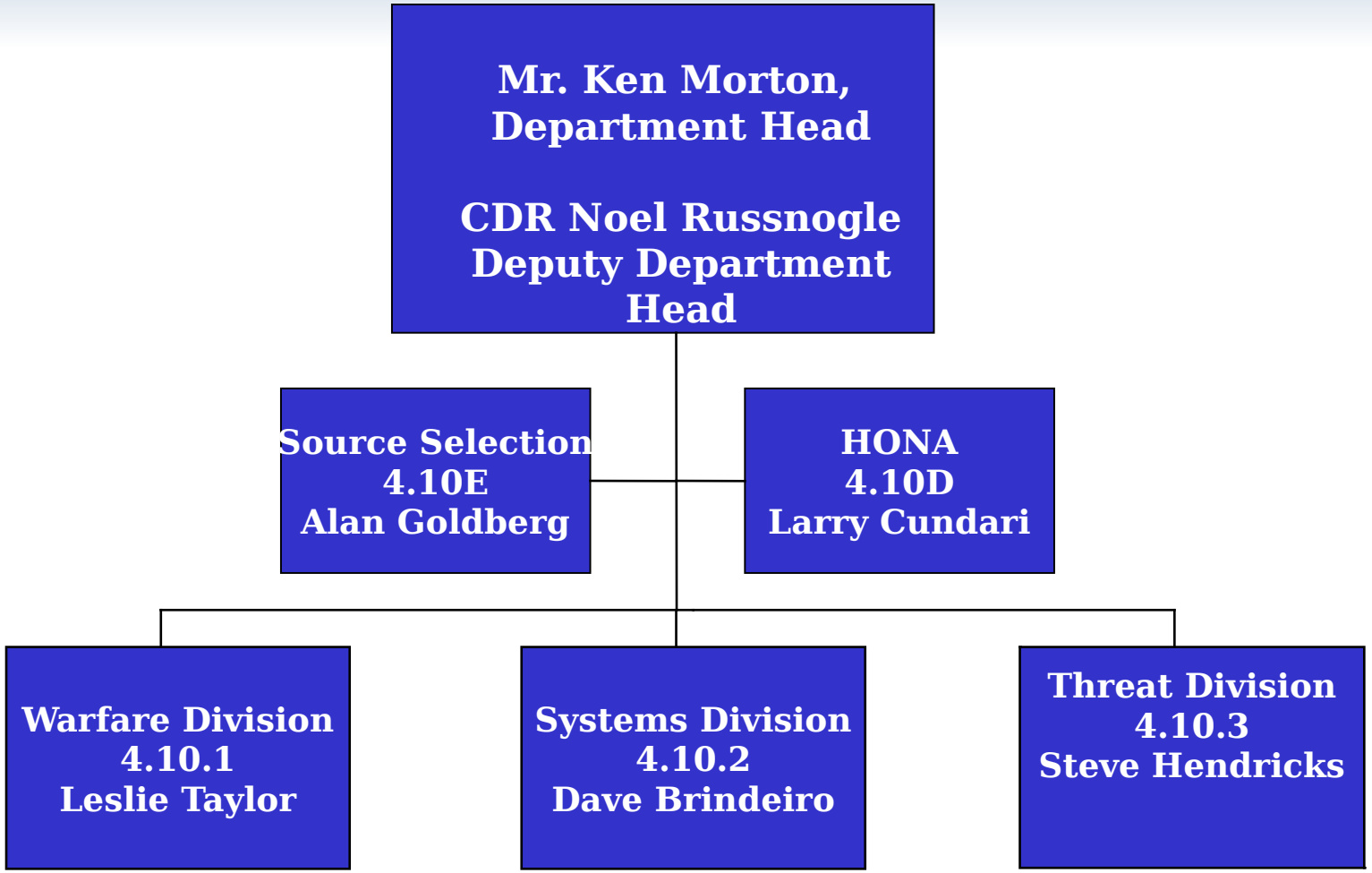
Warfare Analysis Department, AIR-4.10

N00421-04-R-0088 Industry Day Technical Overview

Leslie Taylor

30 August 2004

NAVAIR
Warfare Analysis Department



Capabilities

Systems Division

Systems Modeling & Analysis

- M&S of systems and processes
- Systems performance analysis
- Weapon delivery accuracy

Systems Effectiveness

Airborne Systems Conceptual Design

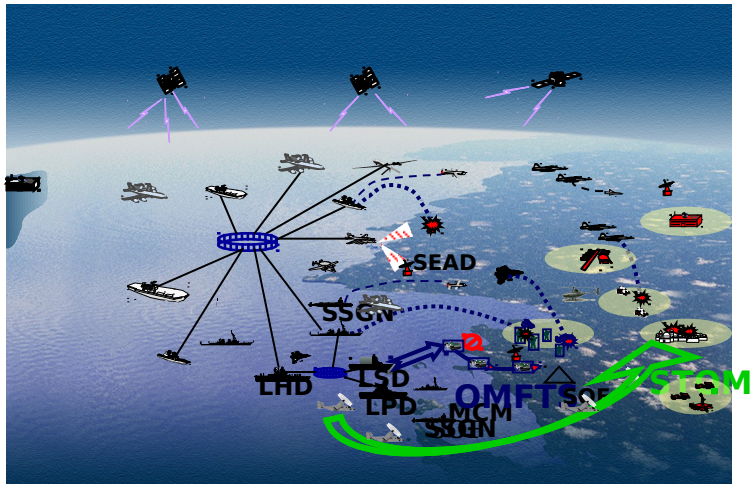
- Air vehicle conceptual design
- Air wing trade studies
- AoA support
- Acquisition feasibility
- Technology insertion

Mission Planning Products

- Paveway Munitions Planning Tool (PMPT)
- Naval Aviation Weaponeering Component
- VX-9 OT support
- Naval Aviation Tech Info

Warfare Division

- Military Utility Analysis
- Capabilities Assessments
- Analysis of Alternatives
- Requirements Analysis
- Battlespace Performance
- System, SoS and FoS Effectiver
- Sea Power 21 Assessments
- Readiness Assessments
- Force Structure Analysis
- Force Investment Strategy
- Operational Concept Developm



Threat Division

Intelligence Products

- Acquisition Program Documentation
- Custom and General Intelligence Briefings
- Threat Definition Documents and Scenarios
- TACAIR EW

Threat Systems Characterization

- Physical, Performance, and Doctrinal
- RF/EW Signals
- LO/CLO Signatures
- Foreign Materiel Exploitation (FME)

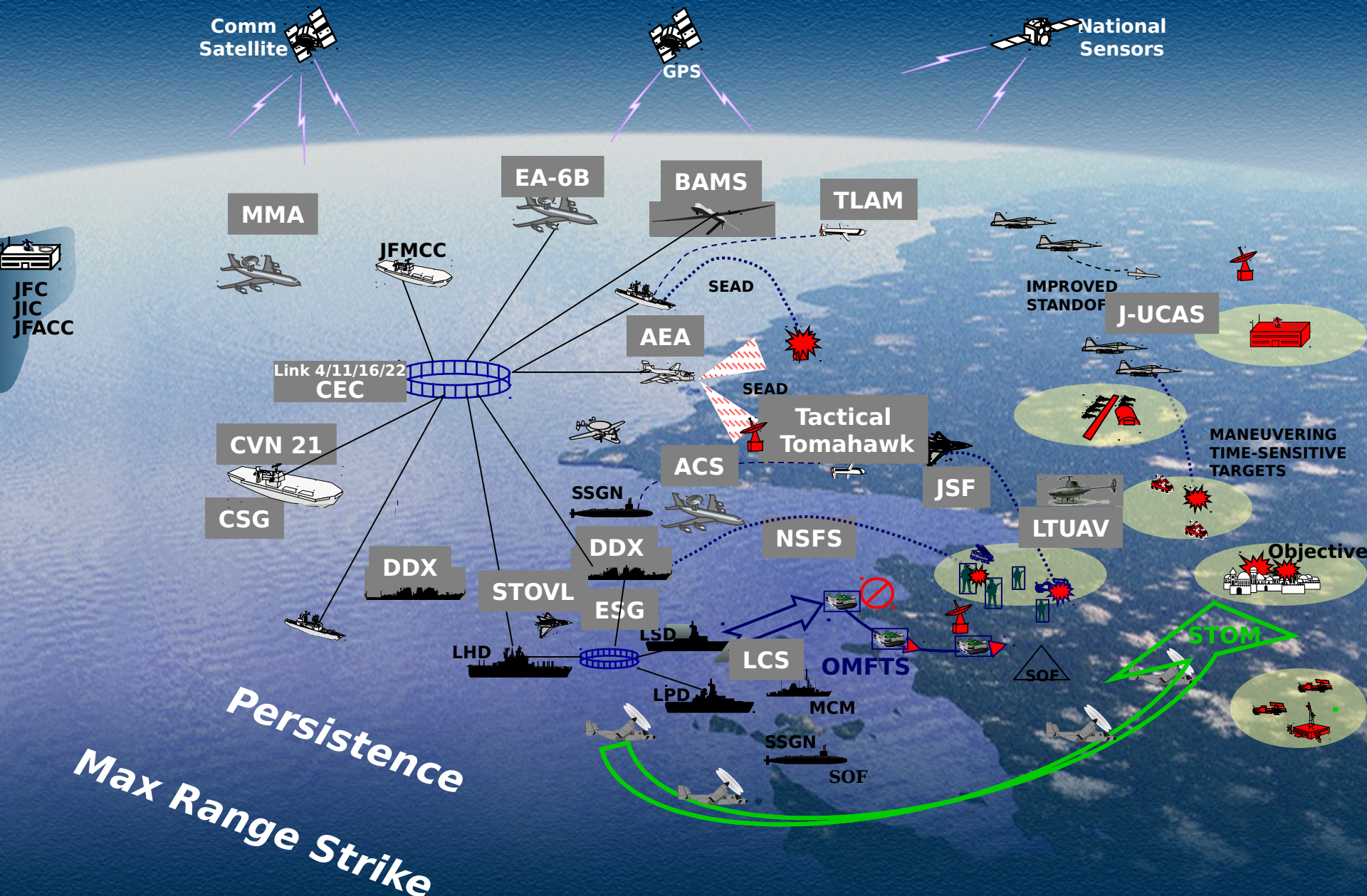
SCI Security Program

Warfare Analysis Mission

Support Fact-based Decision Making in the Acquisition & Sustainment of Naval Aviation Systems through Analysis, Research, and Strategic Planning

QUANTIFY MILITARY WORTH

Persistence in the Battlespace



Demands for Warfare Analysis (PWS 1.2)

- Analytical Agenda of CNO, OSD and the JCS
- Joint Capabilities Integration and Development System (JCIDS) process
- Quadrennial Defense Review assessments
- Sea Power 21 assessments
- Naval Capabilities Development Process (NCDP)
- ONR Research and Development
- OPNAV requirements development
- Defense transformation initiatives
- On-going analysis of acquisition systems
- Fleet support for fielded systems

Performance Work Statement Requirements

Section 3.0

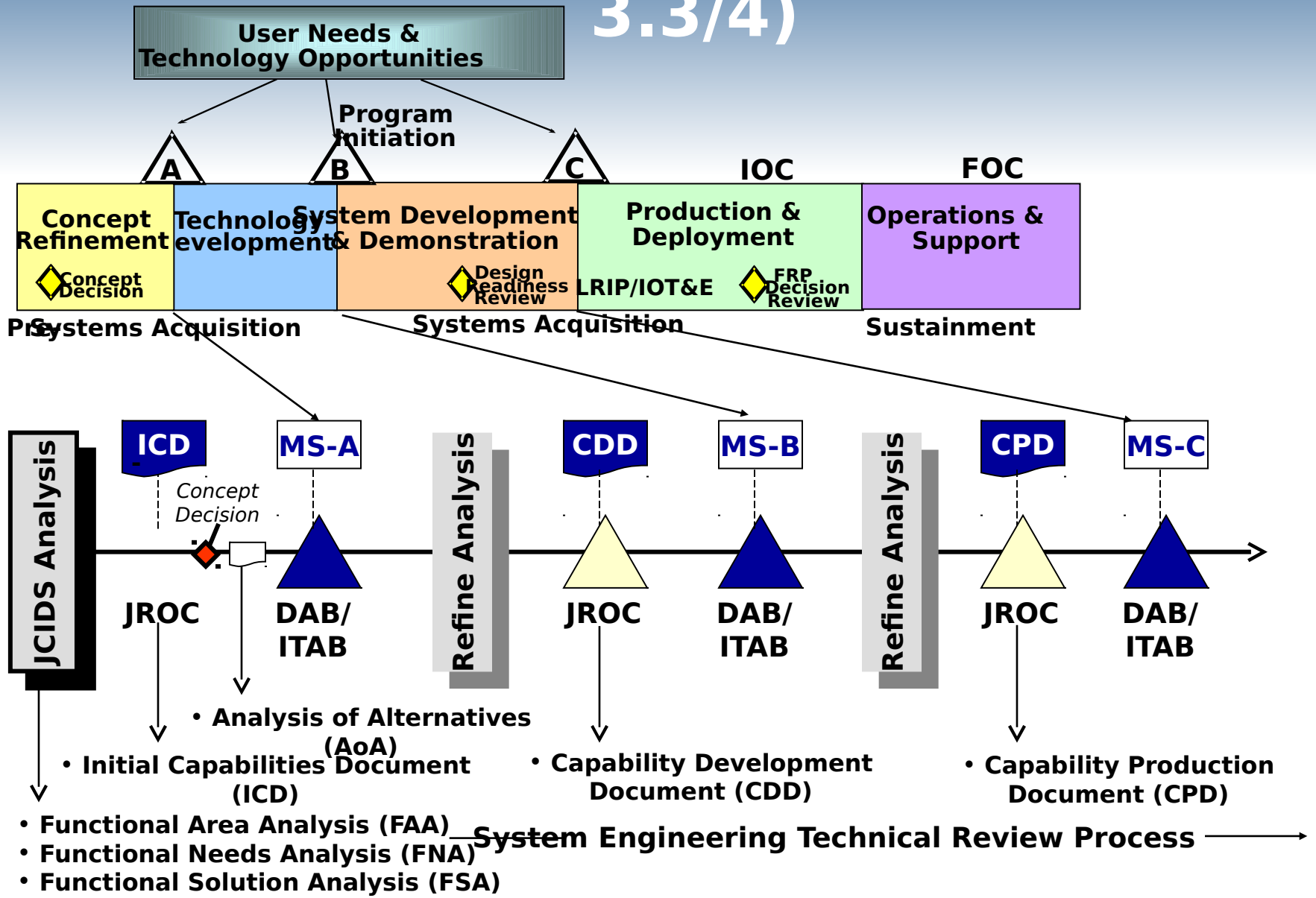
Scope of Warfare Areas (PWS 3.1)

- Anti Air Warfare
- Amphibious Warfare
- Anti Surface Warfare
- Command, Communications, and Control Warfare
- Command, Control and Communication
- Fleet Support Operations
- Intelligence, Surveillance and Reconnaissance
- Information Warfare
- Logistics
- Mine Warfare
- Mobility
- Non Combat Operations
- Naval Special Warfare
- Strike Warfare
- Homeland Defense
- Electronic Warfare
- Strategic Sealift

Task List Analysis (PWS 3.2)

- **Assess the functions and tasks associated with**
  - **Universal Joint Task List (UJTL)**
  - **Universal Naval Task List (UNTL)**

JCIDS and Acquisition Analysis (PWS 3.3/4)



Acquisition Analysis and Support (PWS 3.4)

Perform analysis in support of the Acquisition Process

- Trade-off Analysis
- Make-buy Analysis
- Risk Assessments
- Mission Area Assessments
- Analysis of Alternatives

Support Acquisition Documentation

- Acquisition Plan
- Acquisition Program Baseline
- Analysis of Alternatives
- Capability Development Document
- Capstone Requirements Document
- Command, Control, Communications, Computers & Intelligence Support Plans
- System Threat Assessment Reports
- Technology Development Strategy
- Test and Evaluation Master Plan

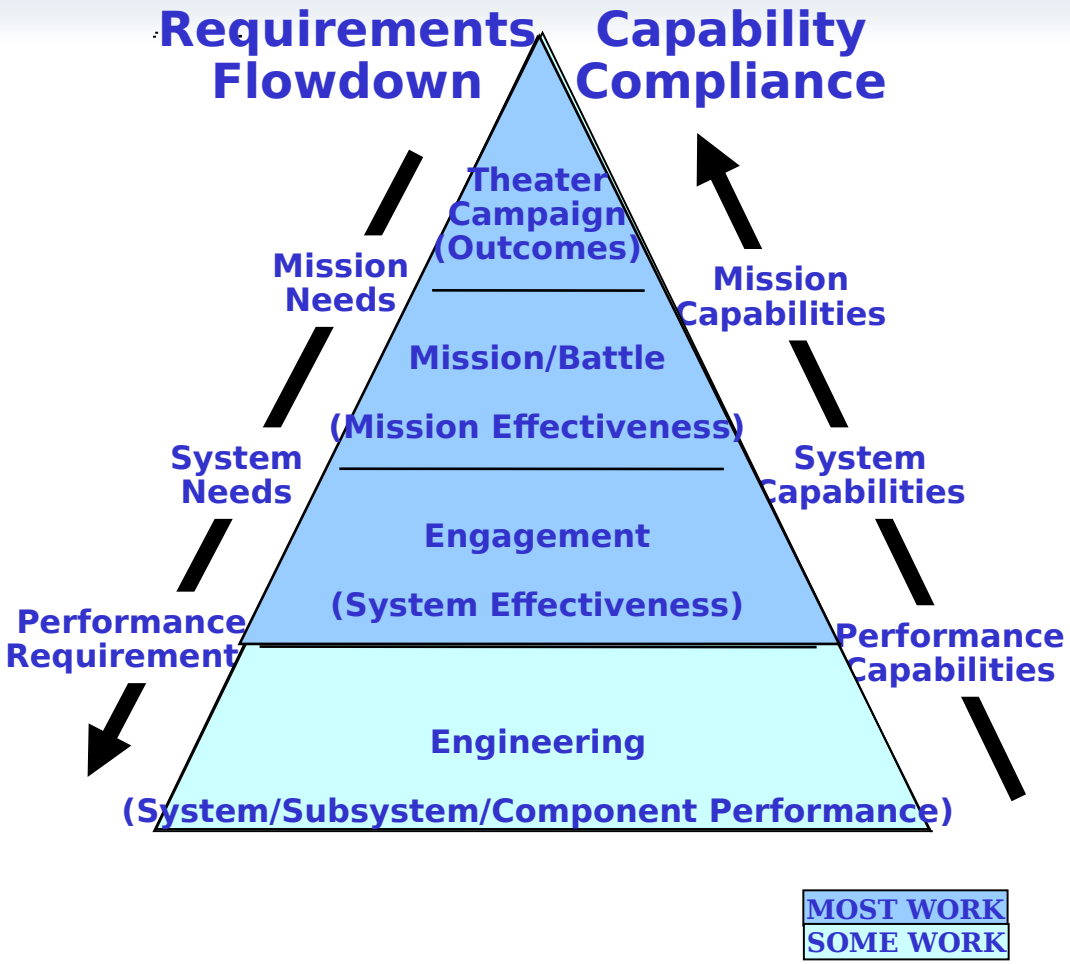
Operational Analysis (PWS 3.5)

Assess Military Worth in the Battlespace: Analysis Capabilities and Flow

- Quantify effect of components, systems or system of systems on a military objective.
- Resulting measure is a function of operational objectives achieved, resources expended, and time required.
- Standard Process involves "managing" 2 of these and evaluating the third.

Rule Sets:
- Environments
- Ops Concepts
- DPG
- Threats and Scenarios
- Existing System Options
- Technology

Opportunities
- Authoritative Data

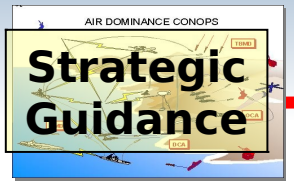


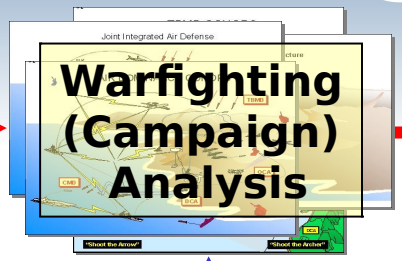
M&S for Operational Analysis

(PWS 3.5)

- Extended Air Defense Simulation (EADSIM)
- Naval Simulation System (NSS)
- BRAWLER
- THUNDER
- Network Warfare Analysis (NETWARS)
- Enhanced Surface-to-Air Missile Simulation (ESAMS)
- General Campaign Analysis Model (GCAM)
- ITEM
- COSMOS
- Joint Services Endgame Model (JSEM)
- Fast Shot-line Generator (FASTGEN)
- Computation and Vulnerability Repair Time (COVART)
- Simulation Package for Evaluation by Computer Techniques - Readiness, Utilization and Maintenance (SPECTRUM)
- Managed Attrition End Game (MAEG)
- SHAZAM
- Active System Performance Estimate Computer Tool (ASPECT)
- Joint Integrated Mission Model (JIMM)

POM Ops Analysis Functions (PWS 3.5)





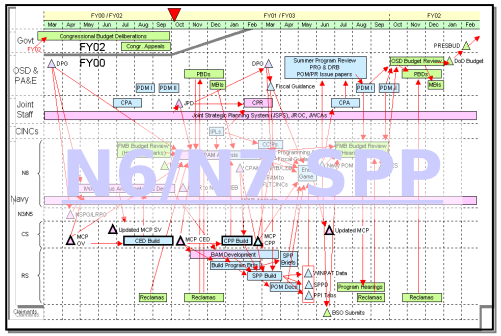
Force Capability Metrics

SYSCOM Assessments

CONOPS

Mission Area Analysis

MCP MCP



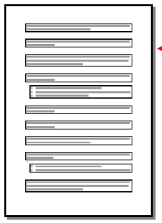
SEA TRIAL

Transform Roadmap

Sea Shield | Sea Strike
NCP
Sea Base | FORCE net

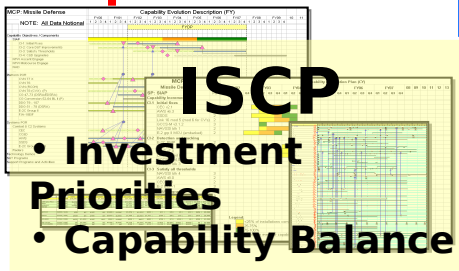
S & T Assessment

Program Guidance



Investment Strategy

SEA ENTERPRISE



Force Structure & Munitions (NNOR) Analyses

Unclassified

Supporting Analysis (PWS 3.6/7.8/9/11)

- **Survivability and Vulnerability Analysis**
  - **Aircraft Damage Repair (ADR) Assessments**
  - **Vulnerability Assessments**
  - **Survivability Assessments**
  - **Susceptibility Assessments**
  - **Managed Attrition End Game**
  - **Battle Damage Prediction**
- **Threat Analysis**
  - **Threat Characterization**
  - **Threat Documentation**
- **Conceptual Analysis**
  - **Advanced, Conceptualized Systems**
- **Systems Analysis**
  - **System Characterization**
  - **Gap Analysis**
- **Cost Analysis**

Readiness, Force Level and Affordability Analysis (PWS 3.10)

- **Readiness Analysis Support**
- **Model Updates and Enhancements**
  - **PRISM (Organizational & Intermediate level simulation)**
  - **RETINA (Depot level repairs and engine repairs)**
- **Baseline Model Development and Validation**
  - **SPECTRUM application of above enhancements**
- **Readiness Simulation Analyses**
  - **Fleet Readiness Problem Analyses**
  - **Resource and Readiness Sustainability Analyses**
  - **Readiness Metrics for Use in Other Models**
  - **Readiness Query Analyses**
  - **Parametric Readiness Analyzer Inputs**

Readiness, Force Level and Affordability Analysis (PWS 3.10)

- **Readiness Data Processing**
- **NADEP Analysis**
- **Engineering Change Proposal (ECP) Evaluation**
- **Force Level Analysis Support**
  - **Naval Aviation Plan**
  - **Long Range Planning**

Analysis Related Support (PWS 3.12)

- Cost-Benefit and Cost Effectiveness Analysis
- Risk Analysis
- DoD and Navy Programmatic Planning and Assessments
- Draft Policies, Procedures and Instructions
- Training Courses and Syllabi
- Modeling and Simulation Support Plans
- Training Systems Analysis

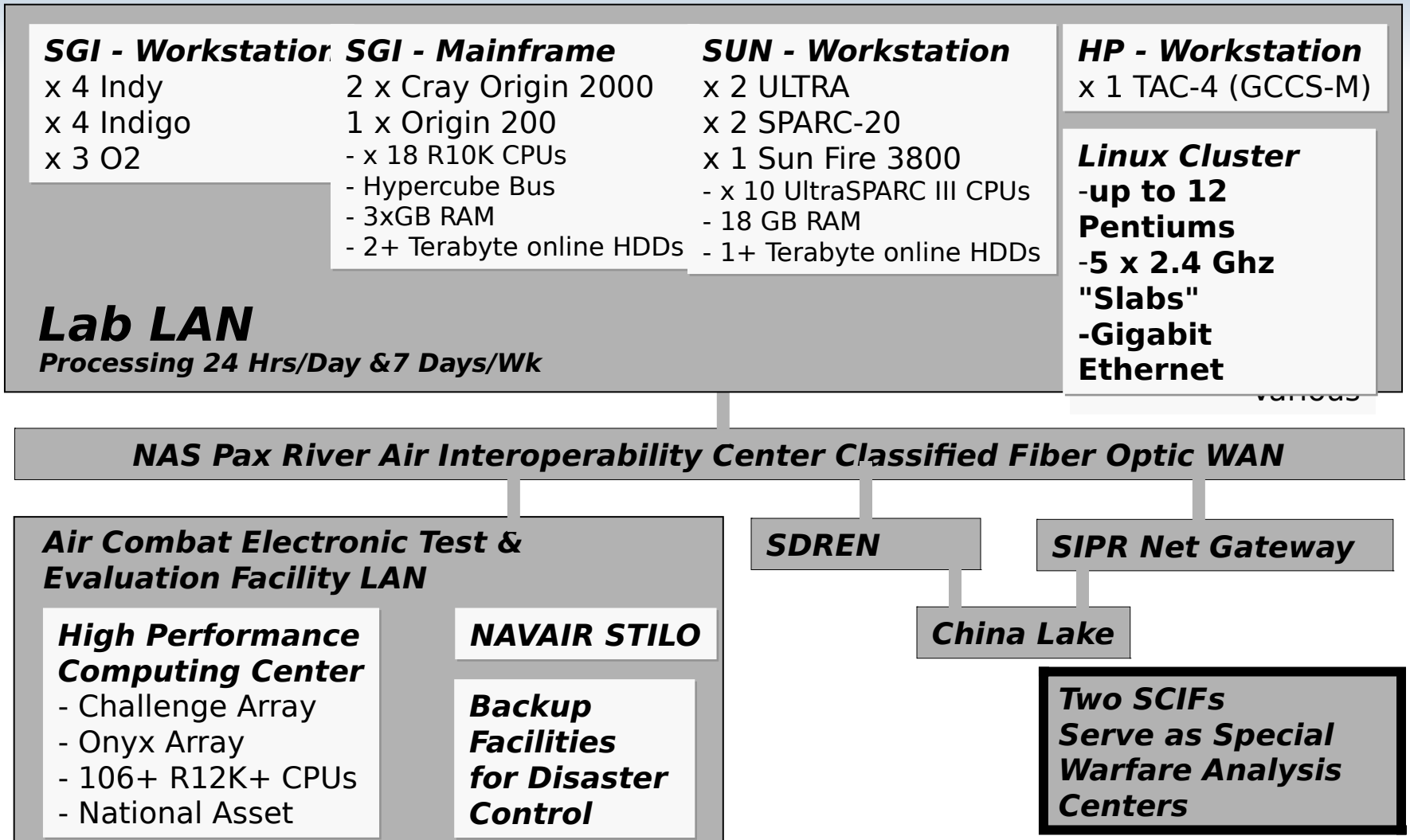
Software Development (PWS 3.13)

- Implement Modeling and Simulation Support Plans
- Develop and Evaluate Models and Simulations
- Modify Models and Simulations
- Implement State-of-the-Art Software Development Practices
- Provide Software Development and Usage Documentation
- Research Develop and Prepare Data
- Perform V&V of M&S, Data, Reports and Templates
- Prepare Accreditation Reports and Templates
- Install and Support M&S applications
- Develop, support, test, and implement distributed simulations
- Provide Configuration Management and Control of M&S and Data

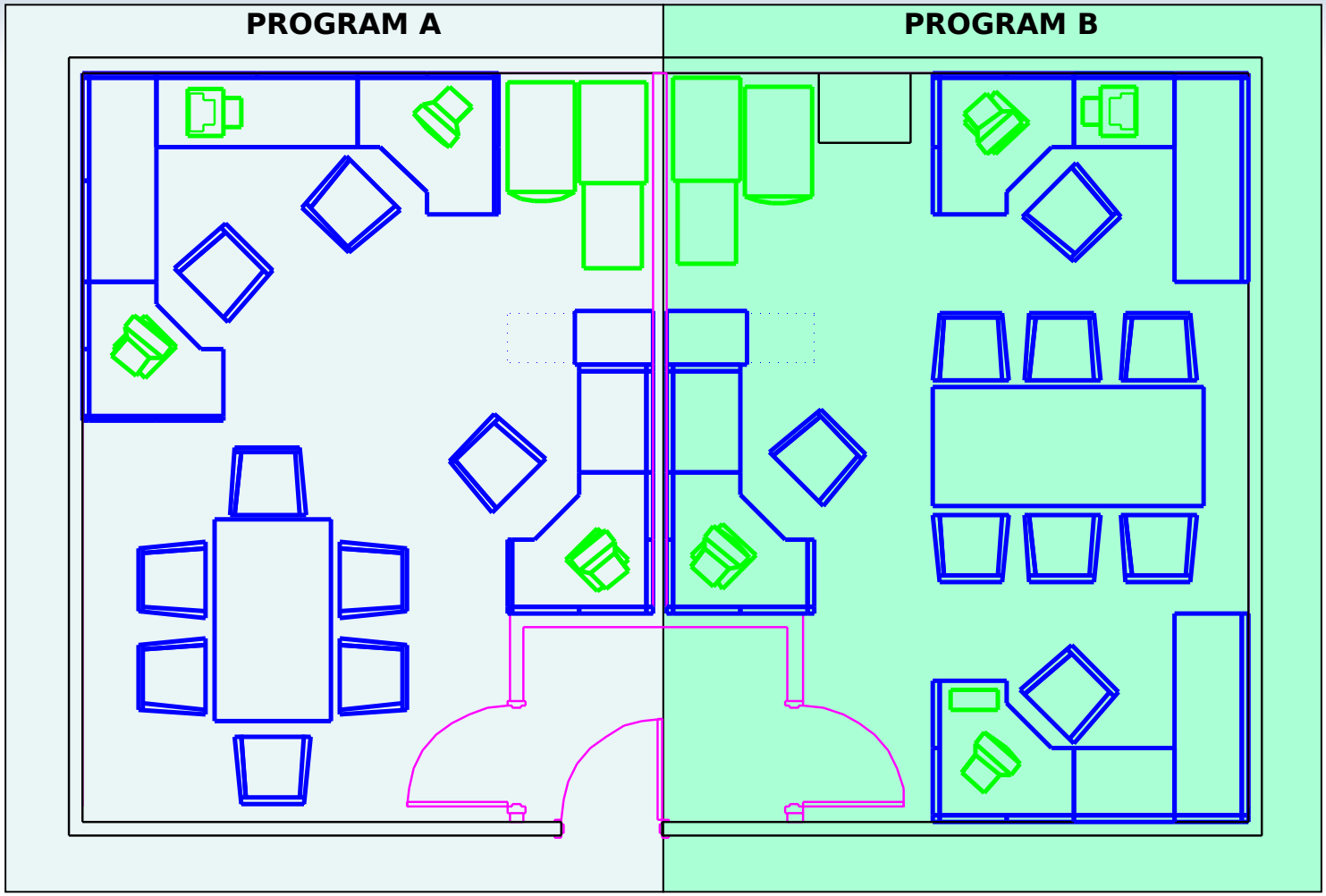
MS&A Infrastructure Support (PWS 3.14)

- Hardware Installation
- Software Installation
- Configuration Management
- Laboratory Management
- Laboratory Procedure Manuals
- Backup and Disaster Recovery Procedures
- Develop or Assist in Developing Hardware and Software Requirements for Laboratory Upgrades or New Laboratories

Warfare Analysis Laboratory



Special Warfare Analysis Center (SWAC)



Building 2187 Room 1A20

Website Support (PWS 3.15)

- **Develop and Support Web-based Applications**
- **Develop and Support Web-based Databases**
- **Develop Websites**
- **Facilitate and Maintain websites including PKI**
- **Perform Web-based efforts with applicable computer security networks, protocols, firewalls and other DoD computer and information, and network protection security schemes**

Data Support (PWS 3.16)

- Develop and support development of datasets representing blue and red systems operating at the campaign, mission, engagement and engineering levels
- Identify Authoritative Data Sources
- Develop Database Plans and Databases
- Perform Data Engineering - types of data, data elements, format and structure
- Develop database filters
- Propose metadata associated with classes of data
- Perform data V&V
- Assist in obtaining data accreditation
- Develop and modify translators to construct input sets to models and simulations as required

Fleet and Operational Support (PWS 3.17)

- **Develop, test, install and support MS&A and related training for**
  - **Course-of-Action Tools**
  - **Tactical Decision Aids**
  - **Battle, Warfare, and Geopolitical Experiments**
  - **War games**

Quality Assurance (PWS 3.18)

- Develop quality assurance procedures and controls
- Develop related documentation
- Support the following reviews
  - Project Planning and Management Reviews
  - Quality Assurance Reviews
  - Requirements Reviews
  - Design Reviews
  - Test Readiness Reviews

Deliverables and Documentation (PWS 3.19)

- Acquisition Documents
- Formal Reports
- Technical Memorandums
- Technical Papers
- Analyst Manuals
- Users Manuals
- Developed Source and Executable Code
- Software Descriptions
- Briefings reflective of Work Performed
- Proposals and Briefings
- Software and Hardware
- Status Reports and Briefings
- Task or Project Review Materials
- Meeting Minutes
- Trip Reports
- Analysis Results

Security (PWS 3.20)

- Efforts from Unclassified through GENSER SECRET, Top Secret and Secret Compartmented Information (SCI)
- Access to SIPRNET is required to perform some tasking
- Types and Classes of Data include
  - Unrestricted Access
  - Proprietary
  - For Official Use Only
  - Source-Selection Sensitive
  - Confidential
  - SECRET
  - SECRET NOFORN
  - Top Secret
  - SCI
  - SAP

Summary

The Warfare Analysis Department ***conducts warfare analysis***, ***simulation***, ***research and strategic planning*** in support of the acquisition and sustainment of naval systems.

BACKUP

JDAM-PIP AoA

Joint Direct Attack Munition Product Improvement Program Analysis of Alternatives

Study

Objective

Evaluate Options for improving JDAM.

Method

- Fractional Factorial Simulation Experiment

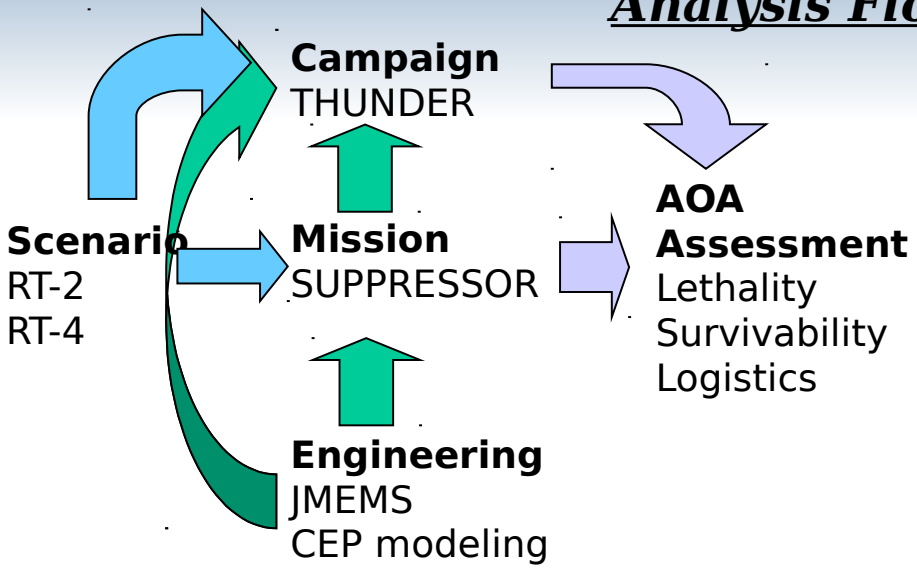
MOEs - *Military Worth*

- Total Targets Attrited
- Phase Exit Day
- Moving Target Kills

MOPs

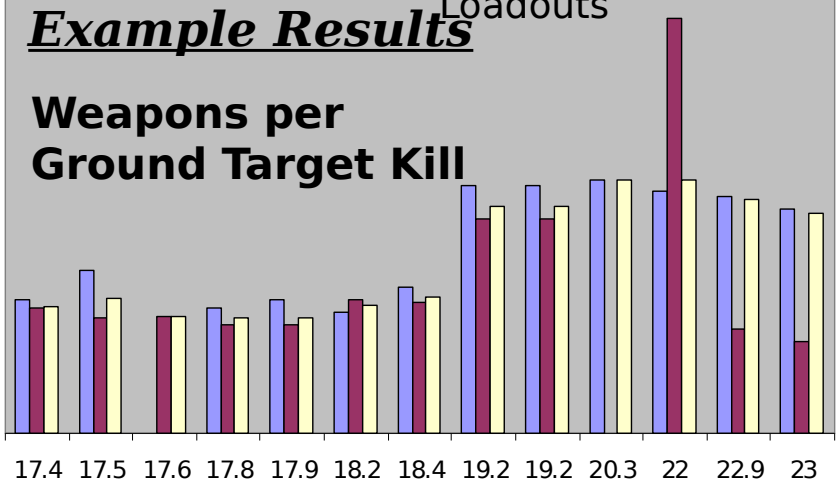
- 3 X Design Factors
- Weather
- Jamming
- Warhead
- A/C & Ship Loadouts

Analysis Flow



Example Results

Weapons per Ground Target Kill



Study resulted in identifying the most cost effective JDAM PIP seeker based concept

Impact

TACTOM / PTAN Campaign Analysis

Study

Objective

- Determine the effectiveness impacts associated with different TACTOM Guidance schemes / CONOPS

MOEs

- Targets Taken Under Attack
- Impact on Ground War

Method

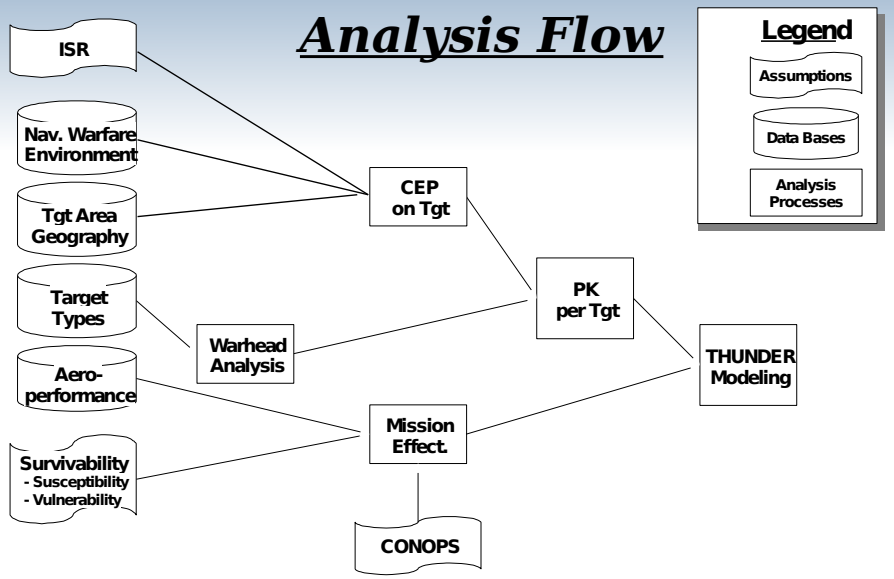
- Simulation experiment using THUNDER

MOPs

TACTOM:

- PK =fxn(Tgt, CEP, Jam)
- Mission Responsiveness

Analysis Flow



Resources

FY 02 - 1.5 workyears
FY 03 - 1.0 workyears

Study resulted in the inclusion of the Precision Terrain Aided Navigation (PTAN) system into TACTOM roadmap.

Follow up work to focus on:

- Warhead options
- Seeker options
- Call For Fire

Impact

Advanced Anti-Ship Weapon Concept Comparison (H21)

Product Overview

- Analysis of Harpoon Blk II-based options to provide common upgrade path for US and foreign customers
- Analysis completed September 2003 to meet UK acquisition cycle decisions

Sponsor

- US Navy (N76), Representatives from UK, Canada, Australia

Resources

- $450K
- Three people full time plus supporting analysts as required

Analysis Approach

- Analysis based on previous anti-ship analysis using ONI approved notional threat ship configurations in the littoral environment
- Alternatives included Harpoon Blk IC and Blk II, a range of seeker options, and configurations including a data link
- Engineering analysis of acquisition capability of each of seeker variants
- Performed separate evaluation of data link candidates, including interoperability issues and jamming
- Evaluated each candidate in 2 tactical situations
- Performance quantified - Probability of Acquisition versus weapon cost

Product

- Final product is an annotated briefing in both hard copy and electronic format, and formal written report
- Progress reviews were provided approximately every 6 weeks

Challenges: Short Timeline (4 months), not all international participants understood analysis process

NAVAL STRIKE FIGHTER HIGH ENERGY LASER (HEL) MODELING & SIMULATION

Product Overview

Develop a man-in-the-loop simulation for a HEL equipped Navy Strike Fighter aircraft (F-18 E/F)

Develop a man-in-the-loop simulation for a HEL equipped A/C-130 Gunship

Simulation will support Naval Aviation participation in the September 2004 Advanced System Wargame (ASW)

- Event is hosted by USAF Distributed Mission Operations Center (DMOC) at Kirtland AFB, NM

Develop CONOPS for HEL Strike Aircraft in this Experiment

- Littoral Scenario
- Common Target Sets

Sponsor

High Energy Laser Joint Technology Office (HEL-JTO)

Advanced Tactical Laser (ATL) ACTD

Resources

< $1M; Awaiting funding

Analysis Approach

General CONOPS of System

- Kill / disable target systems (1. ground/surface; 2. air-to-air)
- Use as sensor
- Detect, classify, kill, and assess battle damage (BD)

Lay foundation for OPNAV assessment:

- Overall effectiveness of system,
- Cost savings
- Impact of HEL on utilization of other weapons drawn down, carrier launch-recovery cycle, etc.; multi-target engagement (jump and settle).
- Multiple kill mode; non-lethal engagement
- Collateral damage management

Challenges: System Objectives, Scenario Event Objectives, Simulation

Product

Initial HEL Strike CONOPS

Naval Aviation HEL

Readiness Analysis

Product Overview

Readiness Analysis Simulation and Modeling

- **Enables the user to relate aviation resources, maintainability, and supportability to readiness and combat sustainability.**
- **It accurately simulates real world conditions and projects desired alternatives.**
- **It provides the user with information to resolve complex logistics problems**

Sponsor(s)

- OPNAV
  - **Readiness Metrics for Campaign Simulation & Modeling**
- NAVAIR (NCDP)
  - **Weapons Throughput Simulation and Modeling**
- NAVSEA
  - **Aviation Requirements for Littoral Combat Ship**
  - **CVN-21**
    - Maintenance Concepts
    - Weapons Throughput

Analysis Approach

- **Define Metric(s)/Selection Criteria**
- **Review Applicable Operational Procedures and Policies**
  - Site Visits
  - Documentation Review
- **Develop Processing Requirements**
- **Identify Data Sources**
- **Collect/Process info from accredited data bases**
- **Establish Baseline Scenario**
- **Execute Models**
- **Perform Readiness Analysis**

Product

- Improved Operational Readiness
  - **Readiness Metric Determination**
  - **Readiness Visibility from 'Concept to Operations and Support'**
- Improved Return on Investment
  - **Resource Investment Impact**
  - **Cost/Benefit Analysis Support**
- Retained Data
  - **Provides baseline for iteration**
  - **Requirements Tractability**
- Infrastructure Change Impact Assessment
  - **Just-in-Time Logistics**

NCDP Analysis/Support

Product Overview

- Provide analytical support to the NCDP Technical Director for the Sea Strike Pillar
  - Evaluate acquisition programs and legacy systems
    - Redundancy
    - Interoperability
    - Reasonableness of cost and performance
    - Program schedule
  - Provide the Warfare Sponsor
    - Ranked priority list of programs and systems
- Provide support for Sea Shield, Sea Basing, and FORCENet Pillars
- Coordinate data exchange among SYSCOMs
- Support analysis efforts by Lead SYSCOMs

Sponsors

- NAVAIR (funding source) in support of N78

Resources

- FY03 - $400K (East Coast)
  - $250K (West Coast)
- FY04 - $890K (East Coast)
  - $670K (West Coast)

Analysis Approach

3 phase process

- Phase A: System-Level Evaluation (conducted by PMs)
- Phase B: System-of-Systems (SoS) Evaluation (conducted by Analysis Team)
- Phase C: A composite evaluation of systems within the context of Systems of Systems (conducted by Analysis Team)

Challenges: Phase B analysis results are driven by the TACSITs – more TACSITs are needed

Products

- Phase A Database
- TACSITs for Phase B Analysis
  - Airfield
  - Moving Target
  - Urban
  - Port
  - Suppression (Jamming)
- ISR Performance Evaluation Tool (ISR-PET) Assessment
- ISR Analyses to Support Strike Missions (ongoing)
- Strike Operations Support – Mission Essential (ongoing)
- SPECTRUM Model (ongoing)

Future Carrier Air Wing Study

Product Overview

- Capabilities Based Analytical study of total number and mix of assets in future carrier air wings (2015-25 timeframe)
- "PHASE I" quick look to address rotary wing, command and control / airborne early warning / electronic attack mission areas by the end of CY02.
- Follow-on for 2003 addressed all other aspects of the CVW's aviation platforms / mission areas.
- Follow-on for 2004 will continue to follow UCAV-N / J-UCAS development, weapons roadmap and organic tanking issues

Sponsor

- N-78

Resources

- ~ 3 work years NAVAIR
- ~ 1 work year CNA

Analysis Approach

- Primary MOE is aimpoints serviced per sortie
- Goal is to provide senior decision makers with a set of analysis-based options in an operational context to examine alternatives
- Leveraged approved existing studies where possible
- Coordinated operational issues with Fleet POCs including NSAWC / COMAEWWINGPAC / etc.

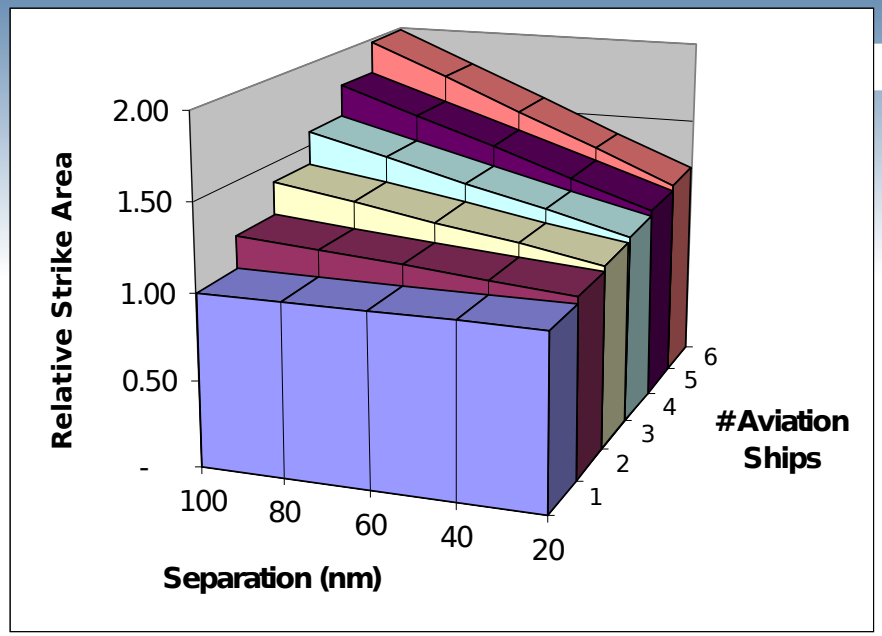
Challenges:

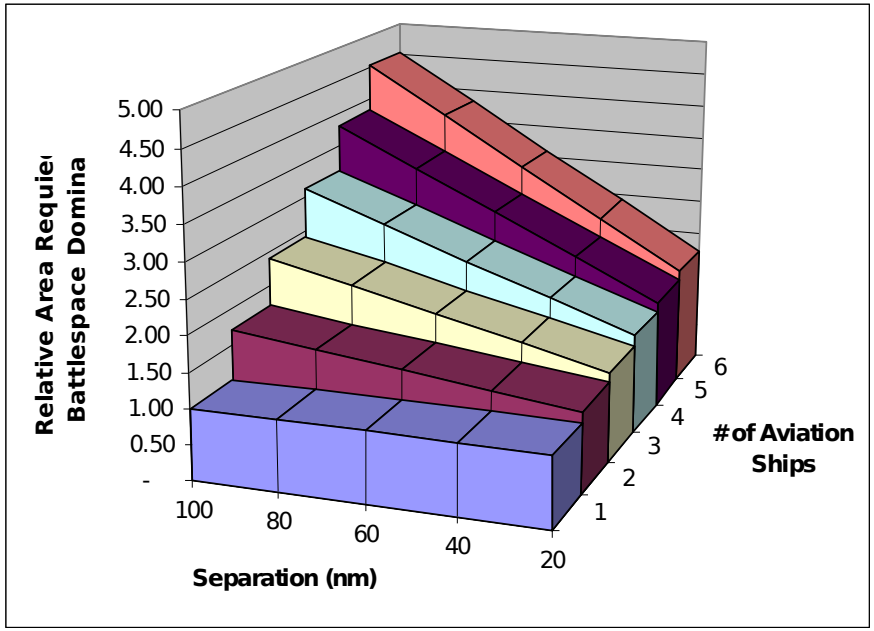
- Some systems such as UCAV-N / J-UCAS are not yet fully defined.
- Relationship between future shore based assets/systems and CVW mission areas is changing (MMA / BAMS, etc.)
- Capabilities based analysis is very broad in nature.

Product

- Annotated briefing of results
- Progress reviews and briefings to N-78 on request throughout the duration of the study

Future Carrier Air Wing - Small Dispersed Carriers





Study

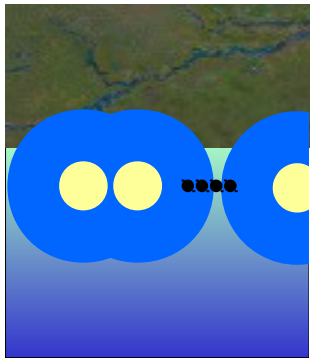
Question: Smaller carriers will be able to disperse throughout a littoral area - broadening the area in which we can strike; Will this effect offset the costs associated with increased battlespace dominance requirements.

Metrics:

- Area within which the projected future carrier airwing can carry out strikes
- Area within which battlespace dominance must be maintained to minimize the risk from surface / subsurface combatants

Analysis Flow:

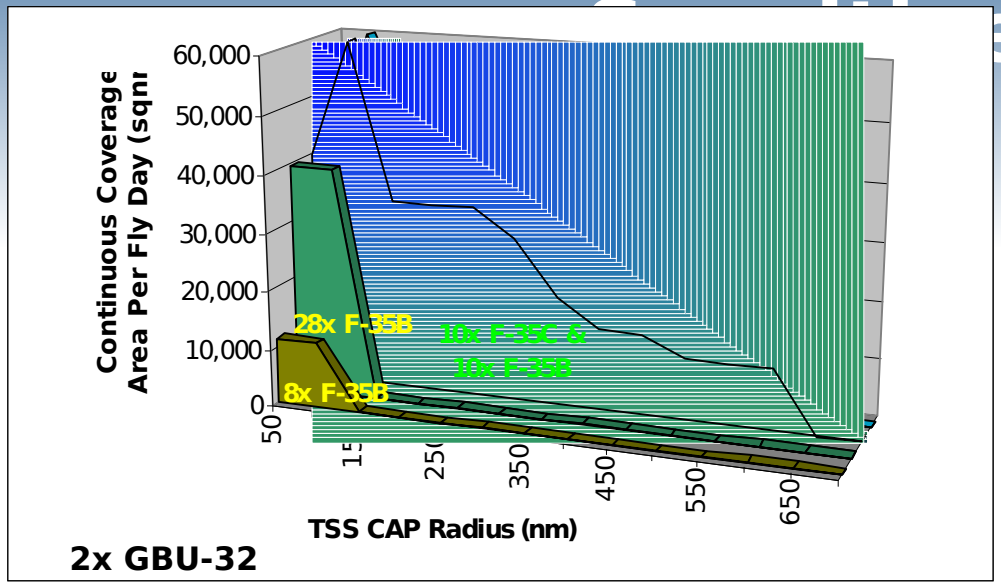
- Simple geometric analysis

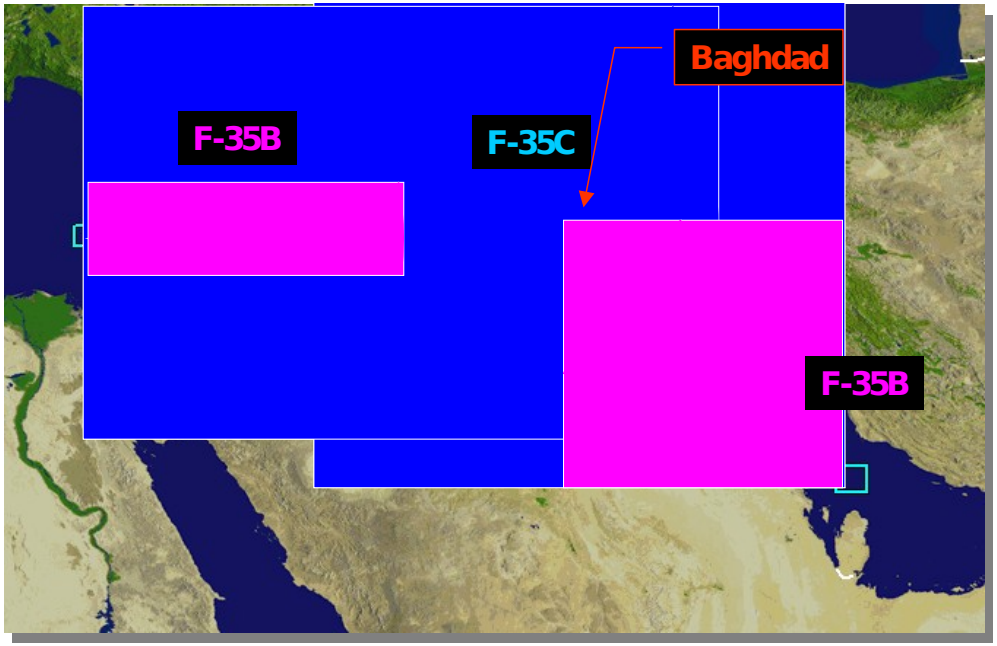


Impact:

- Supported N78 Observation that smaller carriers do not yield significant increases to strike area relative to the increased requirement for battlspace dominance and/or the increased risk of losing at least one CV.

Future Carrier Air Wing - Time Sensitive Strike





Study

Time sensitive strike assessments for evaluating future CVW compositions (STOVL additional utility; tanker allocation, etc.)

Metric: Area within which a single airwing can attack targets with a less than 15 min response time.

- Area can be maintained with reasonable sortie and MC rates for sustained periods -- for ≥ 80% of time over each cycle.
- Organic tanking only.
- F/A-18E/F all fly with 1x480 Gal External Tanks
- F-35C/B fly with no external tanks
- Minimum Cycle Time = 1+15

Analysis Flow:

- Authoritative Aero-Performance Data Package
- Excel Based Tool
  - Allocates tankers
  - "optimizes" cycle time

Impact:

- Supports N78 Future Carrier Airwing Studies
- Other Quick turn studies
- Provided basis for recent N78 support to N7

Joint Strike Fighter (JSF)

Product Overview

- Modeling, Simulation and A
- Air Vehicle Verification

Sponsor

• JSF Program Office

Resources

• 12 Workyears of effort per year

Analysis Ap

•Analytical support to JSF government program office, to include future block requirements trades and excursion analysis. Metrics vary based on type and focus of analysis performed.

•Provide technical subject matter expertise in MS&A

•Analysis support for JSF International Partners

•Challenges:

- Short-notice, quick-turn nature of analysis requests.
- "Joint" program requires close coordination with geographically and organizationally diverse team.
- International releasability considerations of M&S component software and data.
- DoD M&S software development / management practices not yet mature.
- Systems engineering of MS&A - identification of cross-IPT impacts, early and thorough definition of M&S and lab interfaces

Product

• Analysis to support JSF Program Office design and development decisions.

•Technical Subject Matter Expertise on MS&A provided to the JSFPO.

•Facilitation of JSF partner international involvement in MS&A.

•Modeling and Simulation Support Plan (MSSP) update

•MS&A budget and manpower development and management

• Independent testing of MS&A products developed by other organizations.

•Performance verification of threat models used for JSF M&S.

•Force deployments for systems and scenarios of interest to JSF based on documented threat capabilities and tactics.

MULTI-MISSION MARITIME AIRCRAFT (MMA)

Product Overview

- MMA Modeling, Simulation and Analysis

OR

Sponsor

- N78

Resources

Total PE Cost	COST ($ in Millions)						
FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
41.741	68.123	76.243	343.8	505.272	474.897	442.386	403.836

- ~ 6 workyears for MS&A

Analysis Approach

Metrics (KPPs)

- Interoperability
- Mission Radius/Endurance
- Stores Loadout
- Initial On-station Altitude

CLASSIFIED

- Various probabilities of success

Challenges:

- RELATIVELY SMALL MS&A TEAM
- EXECUTION OF VV&A FOR M&S AND DATA
- COLLABORATIVE APPROACH WITH CONTRACTOR

Products

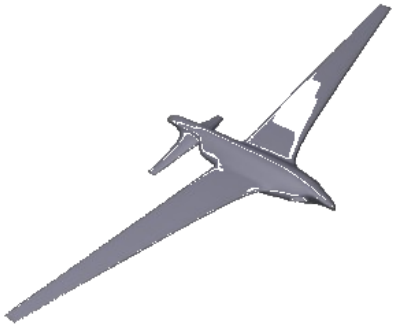
MODELING SIMULATION AND ANALYSIS

- MSSP
- VV&A GUIDELINES
- ORD INPUTS
- CARD INPUTS
- DESIGN REFERENCE MISSIONS OPSITS /TACSITS
- PERFORMANCE BASED SPEC INPUTS
- C4ISP SUPPORT PLAN IMPUTS
- PRODUCT HIGHLIGHTS
  - MSSP SYNERGISM WITH OTHER IPT CDRLs
  - MANDATORY PROGRAM COMPLIANCE WITH JTA
  - USE OF A PBS VERIFICATION MATRIX (UNCLASS & CLASSIFIED)

BAMS UAV

Product Overview

- BAMS UAV Requirements and Specification Support
- Operations Analysis Support



Sponsor

- N78
- PMA-263

Resources

- 1.5 - 2.5 MY

Analysis Approach

- Identify tasks, conditions, and standards needed to achieve military objectives
- Support Functional Area Analysis and Functional Need Analysis input for ORD
- Challenges: Airframe and sensor selection TBD, mission and task applications directly linked to sensor and airframe capabilities

Product

- ORD (ICD), CDD, CPD, CRD Support
- Performance Specification Support
- White papers, reports, analyses and sensitivities as required

Joint Unmanned Combat Air System

Product Overview

• Analysis supports generation of J-UCAS requirements, with emphasis on Navy-unique required capabilities

Sponsor

• DARPA J-UCAS Program Office

•Navy Technical Support Team Lead CDR R. Severinghaus

Resources

• Funded at $50K for interim support through Technical Support Team

•Discussions of analysis support for CDD development on-going

Analysis Approach

•Provide effectiveness analysis assistance and expertise to contractor teams currently determining requirements for demonstrator vehicles

•Challenges: The program is changing quite a bit due to the formation of a joint program from two separate independent efforts by the Navy and the Air Force. There is still quite a bit of negotiating going on to determine roles of some of the participants

Product

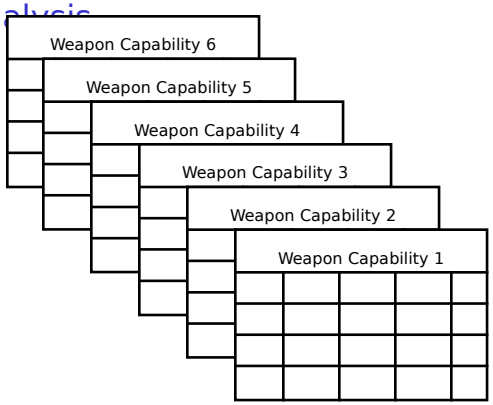
•Document review, analysis assistance and assessment

•CDD supporting analysis products will be annotated briefing in both hard copy and electronic format

Strike Weapons Roadmap

Product Overview

- Strike Weapons Capability Matrix
- System Effectiveness Analysis
- System Availability Analysis



Sponsor

- N-78- LTCOL Chris St. George

Resources

- FY03- $365k
- FY04-TBD

Analysis Approach

•Develop Strike Weapons warhead capability matrix.

•Capability matrix will incorporate current weapons end-of-service life and emerging technology/ POM'd weapons in order to project Strike capabilities through 2020.

•Challenges: Working closely with NSAWC MAWTS and WD competencies the roadmap will utilize tactical scenarios, environmental and technological caveats and include Strike aircraft system(s) availability (software and hardware) to reflect realistic"snapshots" of strike capabilities that are or will become available to the war fighters through 2020.

Product

- Strike Weapon
Roadmap